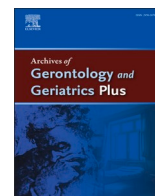




Contents lists available at ScienceDirect

Archives of Gerontology and Geriatrics Plus

journal homepage: www.sciencedirect.com/journal/archives-of-gerontology-and-geriatrics-plus

Effectiveness of music-based interventions in acute care settings for people living with dementia to reduce anxiety and enhance the care experience: A systematic review.

Victoria McArthur^{a,*}, Susan Everington^a, Martyn Patel^{b,c}

^a Radiology Department, Norfolk and Norwich University Hospitals NHS Foundation Trust, Colney Lane, Norwich, Norfolk, UK. NR4 7UY

^b Older People's Medicine Department, Norfolk and Norwich University Hospitals NHS Foundation Trust, Colney Lane, Norwich, Norfolk, UK. NR4 7UY

^c Norwich Institute of Healthy Ageing, Norwich Medical School, University of East Anglia, Norwich, Norfolk, UK. NR4 7TJ

ARTICLE INFO

Keywords:

Dementia
Acute care
Music
Anxiety

ABSTRACT

Introduction: Dementia is a global health priority, with an increasing percentage of overall hospital bed days occupied by people with dementia (PWD). This combined with increased demand and availability of complex scanning means that there is a need for all pathways including diagnostic imaging to consider interventions to improve patient experience and outcomes.

Objectives: Assess the effectiveness of music-based interventions designed to lower anxiety, improve wellbeing and allow better management and care of PWD in an acute hospital setting.

Methods: A systematic search of seven databases was conducted in May 2024, following the PRISMA guidelines. Relevant reviews and articles were also examined for additional sources.

Results: Fifteen studies met the eligibility criteria and were included in this review, which included a total of 581 people with dementia. The studies were of varying design, some with very small sample sizes. Quality of the studies varied, but overall were of moderate to good quality. However, only three studies were RCT and only one of these blinded to the intervention. Overall eleven of the included articles reported a reduction in behavioural and psychological symptoms associated with dementia, with one RCT reporting a significant reduction.

Conclusion: While this review supports the effectiveness of music-based interventions to lower anxiety of people with dementia in acute care it also highlights the need for more robust, high quality trials in a challenging environment. Research should establish the best interventions to enhance the care experience of people living with dementia that can be easily incorporated into acute care settings.

Introduction

The use of music to calm, soothe and distract is a wholly embraced idea. Music is accessible, inexpensive and commonly used in everyday situations. As we all know, often to good effect; music is a universal language. The wide range of situations within which the use of music has been suggested to alleviate symptoms of depression and anxiety is broad from prenatal to incarceration (Mastnak, 2021; Gold et al., 2021; Moshe et al., 2013). Given the ease with which music can be incorporated into varied situations, it is not surprising that music is increasingly being used in care and hospital settings (Ekra & Dale, 2020; Lam et al., 2020).

Music listening in hospital settings has been shown to reduce anxiety (Burrai et al., 2020; Lieber et al., 2019). Live music has been used on

oncology wards resulting in improved communication, calmer and more supportive environments (Apps & Sunderland, 2023) and been shown to reduce anxiety of critically ill patients on ventilation support (Kakar et al., 2021). During angiography, when patients are often awake and only receive local anaesthetic for the procedure, the use of music has demonstrated a reduction in postprocedural pain and reduced time to mobilise (Lieber et al., 2019). Post-operatively music has been shown to lower reported pain and the need for pain relief medication, as well as reduce generalised outcome anxiety (Kakar et al., 2021; Hole et al., 2015 Oct, 24).

There are a range of actions by which music is thought to lower anxiety, decreasing physiological indicators such as heart rate and blood pressure, and diminishing the stress response by lowering cortisol levels

* Corresponding author.

E-mail addresses: victoria.mcarthur@nnuh.nhs.uk (V. McArthur), martyn.patel@nnuh.nhs.uk (M. Patel).

<https://doi.org/10.1016/j.aggp.2024.100087>

Received 23 August 2024; Received in revised form 29 September 2024; Accepted 30 September 2024

Available online 3 October 2024

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(Finn & Fancourt, 2018), plus elevating mood (Schäfer et al., 2013) and a sense of wellbeing.

Music is known for its ability to transport us to another time, allowing visualisation of a happier situation or experience (Jakubowski & Eerola, 2024). Furthermore, music has the power to transcend cultural and cognitive boundaries. Culturally there is evidence that music shares features, regardless of origin, that allows listeners to engage, for example, with the soothing melody of a lullaby or the more complex beat of a dance song (Mehr et al., 2024). Music memory can be understood as hearing music associated with events in our past, that elicits feelings of knowing and evokes autobiographical memories mostly of strong positive emotions such as nostalgia (Jäncke, 2008). Music memory is also a very potent cue, more powerful than a familiar face (Belfi et al., 2016). As cognition is reduced or in cases of advanced dementia appears to be almost completely lost, there is evidence that music memory remains (Devere, 2017).

The World Health Organisation has recognised dementia as a global public health priority (Global action plan on the public health response to dementia 2017–2025 World Health Organisation, 2017) and dementia an increasing health and social care challenge of the National Health Service (NHS). The National Institute for Health and Care Excellence (NICE) estimates that at any one point in time a quarter of all hospital beds are taken up with patients living with dementia (National Institute for Health & Care Excellence NICEimpact dementia, 2020). In healthy patients over 80 years' old, time in hospital and bed rest is associated with decline in mobility and physical and social activity (Tavares et al., 2021). For patients with dementia this decline is accelerated and many studies report dementia increasing the risk of death if a patient is hospitalised with emergency or acute infection (Marengoni et al., 2011; Hapca et al., 2018). A review of hospital outcomes for people with cognitive impairment reported increased risk of poor outcomes including mortality and institutionalisation on discharge, and the increased risk of hospital infections, functional and nutritional status decline which causes delays in patient outcomes (Fogg et al., 2018).

There is the increasing realisation that there is a need in acute care to provide a general dementia-friendly environment; a recent review by Reich (Reich et al., 2022) evaluated published studies on physical and social interventions in acute care that improved clinical or health outcomes for patients with dementia. This review concluded that modifying the physical environment (changes to environmental cues) and creative interventions (such as exercise and multi-sensory behaviour therapy) can improve the experience of people living with dementia (PWD). However, it also revealed the lack of high-quality research and highlighted the need for further interventional studies. When managing agitation and de-escalation in dementia several clinical guidelines recommend that non-pharmacological interventions (such as sensory based therapies) are preferred over pharmacological treatments (Edmans et al., 2021; National Institute of Health & Social Care Excellence, 2019). Increasingly music, singing and musical engagement are being used in both the residential care home setting and in-patient ward-based settings. This is thought to have great potential to contribute to better healthcare outcomes for patients hospitalised with dementia (Parke et al., 2017).

As a research team we wanted to establish whether the use of music as a tool to reduce anxiety and stress had been studied in PWD in an inpatient hospital setting. Our interest stems from diagnostic imaging of PWD. With almost all patients visiting the hospital undergoing some form of diagnostic imaging during their pathway (Response to Health & Social Care Committee Expert Panel, 2022) it is critical that the process happens as fluidly as possible and for patients with cognitive decline this can be one of the most challenging times for them and Magnetic Resonance Imaging (MRI) scans are the most difficult of all due to claustrophobia, noise, length of scans and sensitivity to movement. Patients with dementia not only have cognitive decline, but may also have behavioural and psychological symptoms that need to be considered such as psychosis, agitation, depression and apathy (Challen et al., 2018). MRI

has the potential to distress these patients and they can be overstimulated by environmental factors in the scanner as well as those in the busy Radiology department (Chang et al., 2016).

To our knowledge there has been no review or assessment synthesising the evidence of musical interventions to aid the experience of PWD specific to the diagnostic imaging setting. Therefore, to derive potentially transferable knowledge, we set out to conduct a systematic review of the effectiveness of music-based interventions in acute care settings to improve the symptoms of anxiety and care in PWD.

Methods

Purpose

The primary purpose of this systematic review is to summarise the available research of the effectiveness of music-based interventions for people living with dementia whilst in an acute care setting. The secondary purpose is to establish if music had been evaluated during diagnostic imaging pathways for PWD, and if not generate a synthesis of potentially transferable knowledge from other acute care settings. This review is reported in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA (Moher et al., 2009)) and is registered on the PROSPERO database (CRD42024546419).

Literature search strategy

Eligibility criteria

The PICO (Population, Intervention, Comparator, Outcome) framework established the criteria for inclusion before conducting the literature search. Studies had to be in English language. These terms were developed with a librarian experienced in systematic reviews.

Study selection

Experimental comparative studies of any musical intervention during a visit or procedure in a hospital. These were not restricted to randomised controlled study designs as the authors were aware that there may be a limited number of such trials.

Population

Eligible studies included patients who had been diagnosed with any kind of dementia or cognitive impairment. Studies of patients with delirium or acute confusion were excluded.

Setting

Inpatients in an acute hospital setting (including geriatric hospitals as these can be acute).

Intervention

The eligible studies used any music-based intervention. Initially the intervention was going to take place during a diagnostic imaging procedure, however a preliminary search turned up no studies.

Comparator

Studies with no comparator, a passive comparator, or an active comparator (other kinds of intervention) and the same group in a before or after intervention were included.

Outcomes of interest

Primary outcome

Level of anxiety or agitation. Level of anxiety could be reported as any physiological response or a self-reporting measure such as State Trait Anxiety Inventory (STAI).

Secondary outcomes

- Well-being or other quality of life reports
- Reduction in pain
- Staff knowledge and care management
- Length of stay

Exclusions

- Systematic reviews
- Not using music intervention
- Care homes
- Not published in English language

Literature search strategy

A structured literature search of seven databases (Medline, EMBASE, Emcare, AMED, CINAHL, PycINFO, Cochrane (including CENTRAL)) and was conducted on 05/2024 for relevant studies (see below for search terms). No date limit was applied and all publications until the search date were included. A librarian was consulted on the keywords mapped with the PICO framework. Only full text articles in English were included, relevant systematic reviews and included publications were also searched for relevant texts.

Search strategy (with some adaptations depending on the database):

- “music therapy”mp. Or exp “Music Therapy/ or exp “Music/ or exp Singing/
- exp Dementia/
- 1 and 2
- exp Hospitals/or “acute care”.mp
- 3 and 4
- limit 5 to English

Study identification

Titles and abstracts were screened independently by two authors to exclude duplicates and assess for eligibility. If a disagreement arose, the full text was obtained and reviewed and further discussion took place. Reference lists from the studies were referred to for potential inclusions. Conference proceedings and abstracts were not included unless full text articles were available.

Data extraction

Data were extracted from the included studies based on a standardised data extraction form (Cochrane Public Health Group Template (Cochrane Public Health Group Template, 2023)) slightly modified, developed a priori. Data were extracted by one author and reviewed by the other authors.

Data extracted included the following:

- Author, date, country
- Description of study design
- Setting and sample size
- Type of intervention
- Intervention details
- Outcomes measured

Results

- Main findings
- Study Quality

Due to the heterogenous nature of the patient populations and studies a meta-synthesis was not conducted. A narrative summary of the

included papers is tabulated. The papers are presented in the order of type of study (as indicated in the quality assessment). The narrative synthesis allows the studies to be holistically examined and compared across similar overlapping but not exact matching domains. With mixed-method synthesis the authors felt that a narrative gave the opportunity to combine quantitative and qualitative results from complex populations and interventions and gain understanding of how to implement in healthcare systems and how these acute healthcare environments respond.

Quality assessment

Studies are reported in order of type of study, adhering to the hierarchy of evidence proposed by York Guidance (York Hierarchy of evidence Khan et al., 2001). RCTs were reported first, followed by study designs with an increased risk of bias. MMAT (Mixed Method Appraisal Tool 2018 (MMAT, 2018)) was used to assess the studies and provide a quality score (out of five stars). All three authors independently appraised and rated the included papers. If a disagreement arose a meeting was held and the study re-reviewed until agreement was achieved.

Results

Study selection

A summary of the study selection is shown in Fig. 1 shows the results of the selection process. Of the 148 studies identified, 29 were screened by full text for review and 15 were eligible for inclusion this review.

Characteristics of the studies and populations

The included studies are summarised in Table 1. The studies were carried out in Australia, Greece, Canada, US, Belgium, Finland, Spain, Singapore, UK and the Netherlands.

A total of 581 patients and an unknown number of staff participated in research across 15 studies. Sample size varied from 3 patients to 175. A variety of outcome measures were used (for example: Alzheimer’s Disease Cooperative Study-Activities of Daily Living, Social Disfunction and Aggressive Scale, Menorah Park Engagement Scale, these are detailed in Table 1). The type of music intervention varied from listening to set recorded music, personalised playlists, interaction with group music sessions involving singing and playing of instruments and time with a music therapist. Some music interventions were coupled with exercise, massage, or aromatherapy. The mixture of live and recorded music, group or individualised sessions could be organised by music therapists or other healthcare staff.

Quality assessment

The results of the MMAT quality assessment are shown in Table 2. Three of the studies were RCTs (Lee et al., 2023 Aug, 14; Dimitriou et al., 2022 May, 26; Thornley et al., 2016), the remaining did not utilise randomised designs. It is usually very difficult to blind in such studies which use music and the groups were not comparable at baseline. The nature of the participants (people living with dementia) and the intervention (music) make it difficult to conceal and to blind participants and the staff implementing the intervention. Not all studies discussed the risk of bias in interpreting the results. Two studies using retrospective reporting (Gold, 2014; Thompson et al., 2023), which are at a lower risk of bias. Three of the studies had sample sizes below ten (Gold, 2014; Helmes & Wiancko, 2006; Sival et al., 1997). It is difficult to conclude a clear outcome from such low powered sample sizes, and to obtain statistically robust results.

The patients had all been diagnosed with dementia of varying subtypes and levels of severity. Most studies recruited a heterogeneity of

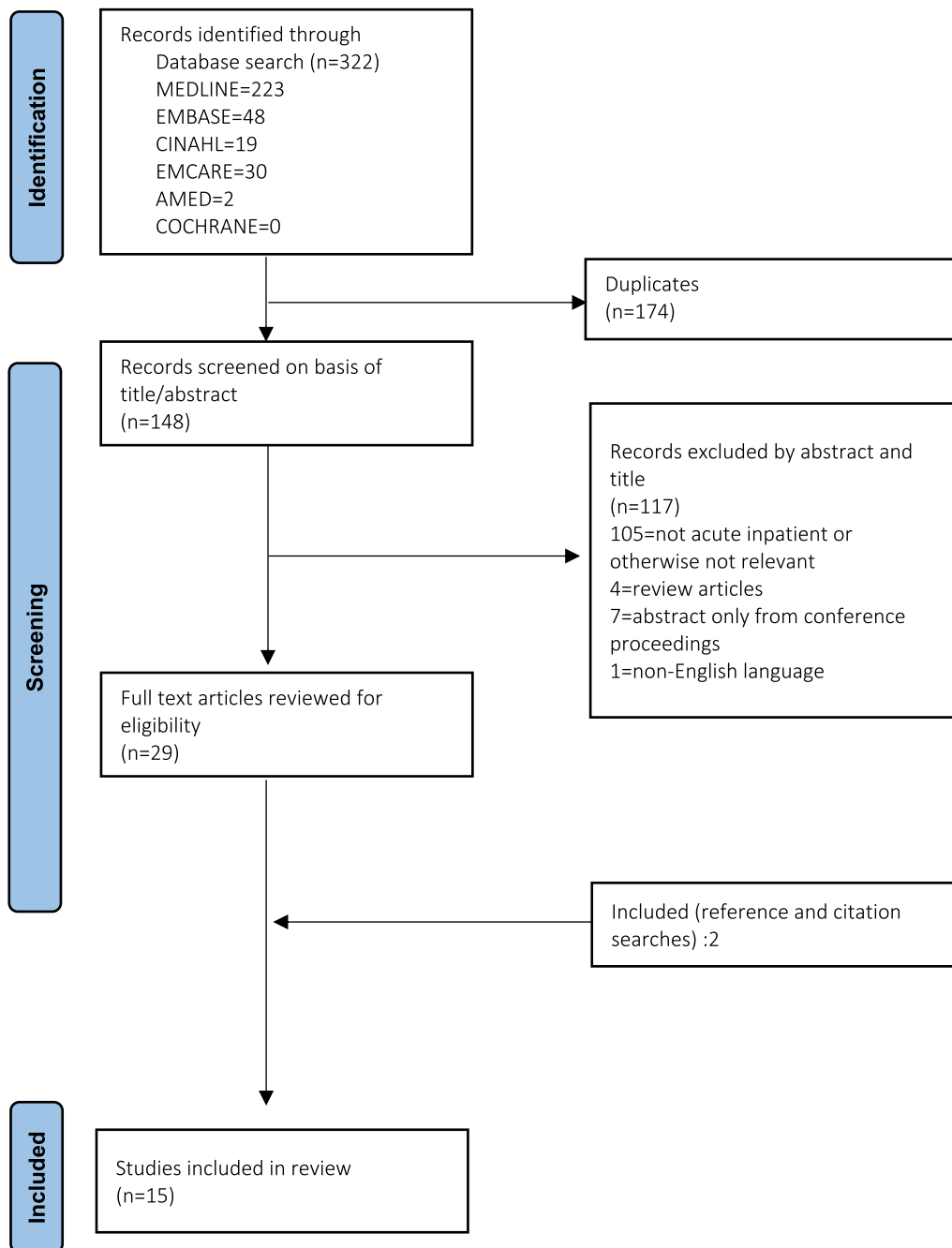


Fig. 1. Study selection and screening procedures.

PWD within these parameters. There was a great deal of variation in the agitation measures used and (a lack of consistency in the measures to report anxiety and agitation make direct comparisons difficult). One study (Thompson et al., 2023) took place during Covid, and the effects of lockdown and reduction or absence of visits from family and lower morale among staff could have impacted the study. However, given the small number of studies and that all had clear research questions and the collected data addressed these questions, all studies were included in the synthesis. Given the variability in study design, method of musical intervention and outcome measures a meta-analysis was not appropriate. The synthesis is presented as a narrative summary of the included literature.

All studies were included in the analysis. Only one study had a two-star quality assessment when rated by the authors (Álvarez Gómez et al., 2019), placing it in the medium to low quality range. The authors

included this study because it was felt that one low to medium quality study would not impact on the overall conclusions and this study provided valuable insights into how interventions could be used in acute care settings.

Primary outcome

Effects of music interventions in lowering anxiety in patients living with dementia

Overall eleven studies reported a lowering in one or more aspects of the behavioural and psychological symptoms associated with dementia (BPSD) (agitation, distress, irritability, noisiness, aggression and disruptive behaviour) and an increase positive mood, wellbeing, pleasure and engagement (Dimitriou et al., 2022 May, 26; Belenchia, 2023; Van de Winckel et al., 2004; Schroeder et al., 2018; Álvarez Gómez et al.,

Table 1
Description of studies.

Author, Year and Country	Study Design	Setting & Sample Size	Type of Intervention	Intervention Details	Outcomes Measured	Results	Main findings	Study Quality
Lee, Chan and Maddison ³⁵ (2023) Australia	Single centre two-arm RC feasibility trial	Geriatric management and evaluation unit (n = 21)	Music playlist of personally curated songs	Pts assigned to control or intervention group. Pts listened to playlist daily for an hour	PAS and CGI for pts and staff interviews and impressions	PAS not significant due to small study size, but staff found the intervention feasible and satisfying and challenged the use of psychotropic medication. Increase in positive mood for staff.	It is feasible for staff to deliver personalised music interventions in a geriatric unit without compromising care.	A strong planned feasibility RCT, let down by low recruitment. Mentioned the limits in differing staff measuring PAS. Difficulty in blinding 4****
Dimitriou et al. ³⁶ (2022) Greece	Cross-over RCT	Neurological Departments of Thessaloniki and Athens (n = 60)	Six non-pharmacological interventions including Music	Patients assigned into six mixed therapy groups composed of: Validation Therapy, Aromatherapy and massage, Music Therapy (preferred music). Interventions lasted for five days.	Patients and caregivers assessed for baseline measures of: MMSE, ACE, GDS, FRSSD, NPI. And after interventions.	Non-pharmacological interventions can reduce irritability in patients with dementia and lower caregiver distress. Significant finding in a combination of therapies.	MT combined with other therapies may reduce agitation.	Not possible to extract the effects of music from the mix with other therapies. 3***
Thornley, Hirjee and Vasudev ³⁷ (2016) Canada	Pilot RCT	Acute inpatient psychiatric unit (n = 16)	Feasibility and acceptance of music therapy as non-pharmacological intervention	Participants randomised to control or four weeks of bi-weekly hour-long sessions with music therapist.	Baseline score of NPI-C and CMAI, then weekly within 24 h of last session.	Pilot data showed no reduction in agitation or distress, and possibly not superior to active engagement with healthcare professionals.	Suspicion that participants unable to meaningfully engage. Suggestion for multi-centred trial and additional RCTs	Small sample size, no blinding, differing levels of dementia 3***
Belenchia ³⁸ (2023) US	Quasi-experimental Paired samples (before and after)	Inpatient medico-surgical unit at Community hospital (n = 21)	Individualised music listening over ten-week period (measurement taken before and after)	Questionnaire to identify individualised music preferences, music supplied on iPod for 30 min in variety of situations.	Pt agitation measured using PAS, (five point Likert Scale (0–4, 0=no reaction, 4= striking caregiver) in four behaviours groups	Post intervention four measures (aberrant vocalisation, motor agitation, aggressiveness and resisting care) all lowered significantly. Staff reported how responsive patients were to personalised music and reduction in agitation.	Individualised music listening is an effective intervention to reduce agitation in PWD and achieve quality patient outcomes.	Smaller sample size, no blindings. 4****
Van de Winckel et al. ³⁹ (2004) Belgium	Quasi-experimental	Psychiatric hospital (n = 25)	15 pts had daily exercise supported by music for 30 mins, 10 pt were control group (equal amount of time with conversation)	Intervention is group exercise with age appropriate music and control patients had one-on-one conversations.	MMSE and Amsterdam Dementia Screening Test Pts tested three times at beginning of experimental period, after six weeks and after 3 months.	Intervention showed improvement in cognition. Significantly higher scores in MMSE and verbal fluency. No change in behaviour. Sample size small, no long-term follow-up.	Daily music-based dance for three months led to higher MMSE scores in PWD. Hypothesised that music enhances arousal and combined with exercise motivates the PWD to be more alert and active.	Smaller sample size, no blindings, groups not comparable at baseline. 3***
Schroeder et al. ⁴⁰ (2018) US	Prospective, Controlled Non-RCT	Geriatric inpatient unit (n = 41)	20 pts treatment as usual and 21 assigned individualised music	Patients assigned to music, had iPod shuffle with personalised music, listened to for a minimum of 30 min/day	Agitation scales (Likert type), resisting care measures and positive and negative mood scales.	Music based intervention group had significantly lower scores on agitation and negative mood scales. Intervention well tolerated by PwD and easily implemented by staff.	Easily implemented music intervention is an effective way to reduce dementia associated neuropsychiatric symptoms.	Small numbers, non-randomised. But authors explore limits and discuss the lack of consistency in measurements of agitation. 4****
Pitkanen et al. ⁴¹	Observation interventional	Acute psychogeriatric	86 in intervention group singing,	Weekly singing, live and recorded music, dancing to music	NPI, MMSE, BI and ADCS-ADL	No evidence that music interventions reduced anxiety, agitation or aggression, and no	No significant differences between the groups. But a possible reduction in anxiety	Activities were not consistently implemented. And pressure of work may

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Table 1 (continued)

Schroeder et al. ⁴⁰ (2018) US	Prospective, Controlled Non-RCT	Geriatric inpatient unit (n = 41)	20 pts treatment as usual and 21 assigned individualised music	Patients assigned to music, had ipod shuffle with personalised music, listened to for a minimum of 30 min/day	Agitation scales (Likert type), resisting care measures and positive and negative mood scales.	Music based intervention group had significantly lower scores on agitation and negative mood scales. Intervention well tolerated by PwD and easily implemented by staff.	Easily implemented music intervention is an effect way to reduce dementia associated neuropsychiatric symptoms.	Small numbers, non-randomised. But authors explore limits and discuss the lack of consistency in measurements of agitation. 4****
(2019) Finland	(Benchmark controlled trial	ward (n = 175)	listening to music, 89 in control.			overall benefit of physical exercise.	and improved sleep in the intervention group.	have effected delivery. 5****
Álvarez Gómez et al. ⁴² (2019) Spain	Cross-sectional observational	Acute geriatric ward (n = 32)	Recorded music	One to two short (15 min) of music (ranging from more to less relaxing) played over headphones and patients responses observed.	Observed responses by three healthcare providers, generalised responses were recorded before and after and to the type of music.	27/32 patients showed positive responses (smiling, sang, danced, exhibited pain relief), two indifferent, one aggressive. Better response to familiar melodies of youth.	Music stimulus, appropriate used and timely help relax and divert PWD.	Some of the outcome data are not clear, in the form of letter to editor. 2**
Cheong et al. ⁴³ (2016) Singapore	Observational pilot study	Acute hospital geriatric ward (n = 25)	Creative music therapy	Music therapist active music making or playing	MPE and Lawton OERS	Positive MPES was observed during the creative music sessions, and pleasure and alertness had higher occurrences during the sessions. Significant results.	Key finding that MT could have use in shorter-term settings such as acute care. Useful in wound dressing, medication, OT, benefits in mood and engagement	Smaller scale, No lasting effect beyond the sessions, confounders not accounted for. 4****
Gold ⁴⁴ (2014) United Kingdom	Observational service audit	Hospital (n = 9)	Music therapy	Music therapist listening and active playing of instruments	Care notes made by staff and recorded against negative and positive moods and behaviours compiled from dementia assessment scales.	8 out of 9 patients showed consistently more positive and fewer negative moods	Small scale, retrospective observations made by nursing staff. Care notes are a useful (unbiased) way to collect impact of interventions	Small scale audit, but care notes are a rich source of retrospective data. 4****
Helmes and Wiancko ⁴⁵ (2006) Canada	Single observational studies	Acute care hospital (n = 9)	Recorded music	Baroque music for 30 min periods (it included Pachelbel's canon!!)	Total number of shouts and bangs recorded per 30 min session.	Noisy and disruptive behaviours all lowered, in all but two extremely disruptive cases. Noted tailored music might improve outcome. Not significant.	Simply playing music maybe as effective as MT. Secondary outcomes included positive effects on wellbeing of staff.	Small scale, limited music genre (baroque music), Short interventions (30 min), observer bias, multiple observers, no blinding. 4****
Sival et al. ⁴⁶ (1997) Netherlands	Interventional and observational	Psychogeriatric hospital (n = 3)	Baseline, intervention and follow-up of using group, musical and physical activities.	Three x 4wks baseline, intervention and follow up. Interventions included games, singing, music (listening, live or recorded) and physical activities (walking, ball games, swimming, biking)	Measurement included GIP, SDAS, and CGI a global observation scale.	Patient A worsened in intervention, but improved during follow up. Patient B improved on global function, intervention appeared to have lasting effect, patient C's response was not clear.	Observational staffing outcomes clearer, more attention by staff during day.	Small scale, no standardised intervention, variable results, no clear pattern. 3***
Thompson et al. ⁴⁷ (2023) UK	Mixed-methods retrospective observational	Two inpatient psychiatric wards	Music therapy (MT)	One hour weekly open music therapy by HCPC music therapist	Retrospective reporting on NHS secure Incidents system (Datix) on days with and without music therapy, and semi-structured interviews with staff	Significant reduction in disruptive and aggressive behaviour, staff reporting that intervention is meaningful. MT reduced need for antipsychotic medication.	Music therapy showed significant reduction in disruptive behaviour on days with in-person music therapy compared to none. Staff reported it an accessible and meaningful intervention to lift mood.	Observational study, small sample Risk of bias. 4****
Daykin et al. ⁴⁸ (2018) UK	Exploratory sequential mixed methods	Acute elderly care hospital (n = 85)	Weekly inclusive participatory music activity	Unstructured observation of music sessions and brief interviews post music. Plus focus group of carers	Thematic analysis Quantitative data on falls, length of stay, antipsychotic prescriptions and ArtsObs to	Decrease in length of stay, falls, reduction in patients prescribed antipsychotic medication during the period of music activity. General observational data is	Overall strong positive effect on clinical environment. Responses to music are a wide range of emotions.	Limits to study. Variation in ages of cohorts in two time periods. Deal of difficulty in comparing

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Table 1 (continued)

Daykin et al. ⁴⁸ (2018) UK	Exploratory sequential mixed methods	Acute elderly care hospital (n = 85)	Weekly inclusive participatory music activity	Unstructured observation of music sessions and brief interviews post music. Plus focus group of carers	Thematic analysis Quantitative data on falls, length of stay, antipsychotic prescriptions and ArtsObs to record mood, distraction, relaxation and happiness	Decrease in length of stay, falls, reduction in patients prescribed antipsychotic medication during the period of music activity. General observational data is music is a strongly positive effect on the clinical environment. No statistical analysis.	Overall strong positive effect on clinical environment. Responses to music are a wide range of emotions.	Limits to study. Variation in ages of cohorts in two time periods. Deal of difficulty in comparing the two periods. 3***
					record mood, distraction, relaxation and happiness	music is a strongly positive effect on the clinical environment. No statistical analysis.		the two periods. 3***
Melhuish ⁴⁹ (2013) United Kingdom	Pilot project of mixed methods	Acute inpatient facility (n = 22)	Music therapy	Ten weekly sessions of one hour with a music therapist with staff support	Analysis of session notes using simple scales to measure wellbeing and relationships.	Therapist and staff noted changes in wellbeing, engagement and relationships.	Overall positive impact and increased attendance over time. But some anxiety noted, also	Limits with staff not able to support in running and evaluation. 3***

Acronyms for outcomes measured.

MMSE-Mini Mental State Examination-30 point questionnaire to evaluate cognitive status.

ADCS-ADL-Alzheimer's Disease Cooperative Study-Activities of Daily Living.

CGI- Clinical Global Impression.

ACE-R Addenbrook's Cognitive Examination Revised-100 point questionnaire to evaluate cognitive impairment.

GDS=Geriatric Scale of Depression-30 questions to examine if patient has depression.

FRSSD-Functional rating Scale for Depression-a questionnaire to caregiver on 14 different daily activities.

NPI-Neuropsychiatric Inventory (C is Clinician version), a questionnaire administrated to caregiver to rate frequency and severity of symptom.

CMAI-Cohen-Mansfield Agitation Inventory.

ArtsObs-Arts Observational Scale.

SDAS-Social Disfunction and Aggressive Scale.

MPES-Menorah Park Engagement Scale.

OERS-Observed Emotion Rating Scale.

BI-Barthel Index.

PAS-Pittsburgh Agitation Scale.

GIP-Behavioural Rating Scale for Psychogeriatric Inpatients (Gedragsobservatieschaal voor Intramurale Psychogeriatric).

Table 2
Results of MMAT appraisal.

Authors	1. Screening questions (for all types)		2. RCTs					Rating
	S1. Are there clear research questions?	S2. Do the collected data address the research questions?	2.1. Is randomization appropriately performed?	2.2. Are the groups comparable at baseline?	2.3. Are there complete outcome data?	2.4. Are outcome assessors blinded to the intervention provided?	2.5. Did the participants adhere to the assigned intervention?	
Lee, Chan and Maddison (2023) 35	Y	Y	Y	Y	Y	N	Y	4****
Dimitriou et al. (2022) 36	Y	Y	Y	Y	Y	N	Y	3***
Thornley, Hirjee and Vasudev (2016) 37	Y	Y	Y	N	Y	Y	Y	4****
3. Quasi-experimental (same appraisal as RCT, see above)								
Belenchia (2023) 38	Y	Y	N/A (paired)	N	Y	N	Y	3***
Van de Winckel et al. (2004) 39	Y	Y	Y	Y	Y	N	Y	4****
4. Non RCT			4.1. Are the participants representative of the target population?	4.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?	4.3. Are there complete outcome data?	4.4. Are the confounders accounted for in the design and analysis?	4.5. During the study period, is the intervention administered (or exposure occurred) as intended?	
Schroeder et al. (2018) 40	Y	Y	Y	Y	Y	N	Y	4****
5. Observational (same appraisal as non RCT)								
Pitkanen et al. (2019) 41	Y	Y	Y	Y	Y	Y	Y	5*****
Álvarez Gomez et al. (2019) 42	Y	Y	Y	?	?	?	Y	2**
Cheong et al. (2016) Singapore 43	Y	Y	Y	Y	Y	N	Y	4****
Gold (2014) 44	Y	Y	Y	Y	Y	N	Y	4****
Helmes and Wiancko (2006) 45	Y	Y	Y	Y	Y	N	Y	4****
Sival et al. (1997) 46	Y	Y	Y	Y	Y	N	Y	3***
6. Mixed-methods			6.1. Is there an adequate rationale for using a mixed methods design to address the research question?	6.2. Are the different components of the study effectively integrated to answer the research question?	6.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?	6.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	6.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?	
Thompson et al. (2023) 47	Y	Y	N	Y	Y	Y	Y	4****
Daykin et al. (2018) 49	Y	Y	N	Y	Y	Y	Y	4****
Melhuish (2013) 48	Y	Y	Y	Y	Y	N	N	3***

2019; Cheong et al., 2016; Gold, 2014; Helmes & Wiancko, 2006; Thompson et al., 2023; Daykin et al., 2018; Melhuish, 2013). The single centre two-arm RC feasibility trial (Lee et al., 2023 Aug, 14) found no significant change in PAS (noting that this study was underpowered as it was a pilot study) but staff found the intervention satisfying and feasible, and there was an overall positive mood. This was the only study to use a personally curated playlist and the risk of bias was clearly discussed along with changes in day to day staffing which could result in subjective measures.

Only one RCT found a significant reduction in anxiety (Dimitriou et al., 2022 May, 26) but music was grouped with other interventions and therefore it is not possible to extract the effects of music alone. Of the other two RCTs Lee et al. (Lee et al., 2023 Aug, 14) found no significant reduction in PAS, possibly due to low recruitment and Thornley et al. (Thornley et al., 2016) showed no change after hour long sessions with a music therapist. Discussion on this study suggested that PWD found it difficult to meaningfully engage.

Two studies reported no reduction in agitation or distress (Thornley et al., 2016; Pitkänen et al., 2019). One study (Sival et al., 1997) detected no clear or significant pattern but the sample size was very small (three). One study did not measure BPSD but looked into cognition using the MMSE (Van de Winckel et al., 2004). This quasi-experimental design found significantly higher scores in MMSE and verbal fluency post-intervention (group exercise with age-appropriate music). It is still unclear whether music and music sessions delivered by music therapy is as effective as playing music alone might be. Types of music, duration and long-term benefits of music remain unclear. One study reported a better response to familiar melodies from youth (Álvarez Gómez et al., 2019), again there is a need for rigorous controlled trials on the most effective genre, duration and delivery of music.

Secondary outcomes

One study reported that as well as the distress of PWD being lowered, music was also effective at lowering care-giver distress (Dimitriou et al., 2022 May, 26). This study reported if severity and frequency of anxiety in PWD is less, then care-givers feel better without this unwanted behaviour and have better wellbeing and are more able to cope.

Several studies reported that healthcare staff liked the addition of music and detected a change in morale (Lee et al., 2023 Aug, 14; Schroeder et al., 2018; Thompson et al., 2023; Daykin et al., 2018) and had positive perceptions of music-based interventions, even as much as reducing staff absence on music days (Daykin et al., 2018). Music was also seen to be a feasible and easily implemented intervention (Lee et al., 2023 Aug, 14; Schroeder et al., 2018).

In addition to positive impacts on staff and environment, studies reported either a lowered need for psychotropic medication (Thompson et al., 2023; Daykin et al., 2018) or challenged the need to use such medications (Lee et al., 2023 Aug, 14) Potentially by highlighting the use of alternatives to reduce anxiety, staff would think twice before prescribing psychotropic medications. Another study recorded a decrease in number of falls over the time period of the music intervention and a small reduction in length of stay (6.2%) and discharges increased by 9.8% (Daykin et al., 2018).

Discussion

Main findings

The aim of this review was to assess the effectiveness of music interventions in acute settings to improve the symptoms of anxiety in people with dementia (PWD) and to determine if any studies had taken place in diagnostic imaging settings. Given no studies were identified in the diagnostic imaging setting, this activated a secondary aim of deriving potentially transferrable knowledge from the experience of other acute settings.

Music and music therapy (either alone or in combination with other therapies) reduced patient anxiety levels in 11 out of 15 studies (only five of these had significant results^{36, 38, 40, 43, 47}). Four studies reported that staff liked the music interventions (Lee et al., 2023; Belenchia, 2023; Thompson et al., 2023; Melhuish, 2013).

The studies included in this review were found to clearly state a research question and demonstrated appropriate data collection (Table 2). However, they were, for the most part small, three had fewer than ten participants and 11 had fewer than 40 and were only carried out on single sites. The studies used a variety of music-based interventions (alone or in combination with other interventions) and measured different measurement variables for anxiety. From the MMAT (Table 2) it can be seen that the methodologies varied from RCTs to observational and exploratory mixed-methods. Given the varying methodology and data collected it was not possible to directly compare studies. It is to be hoped that the pilot and exploratory studies lead to more rigorous RCTs. This reflects a need for high quality studies into non-pharmacological interventions for PWD, also supported by other systematic reviews (Reich et al., 2022; Backhouse et al., 2020).

In many of the studies recruitment was low, with only three studies having over 50 participants. Low recruitment will result in less clear outcomes and is reflected across the literature in studies involving people living with dementia. Often the difficulties with recruitment are around a hard to reach population (although in this review PWD are in acute care), the time taken to recruit, issues around consent and capacity and then an unwillingness or inability to participate. Successfully recruiting studies have often involved recruitment in a dyad (with a family carer), identification of eligible participants, active clinical engagement by staff, understanding and sustaining the workforce to deliver the intervention, and flexibility around the varying capacity of PWD to engage (Field et al., 2019). Music has the benefit of being universally appreciated and this is a link to engage participants, carers and staff.

The included studies had a mix of dementias and PWD at various stages along their pathway. The Alzheimer's society reports that although dementias can be categorised into early, middle and late, the trajectory is not a straight line and capacity fluctuates (About Dementia, 2024). This makes it difficult to clearly label a stage of dementia. However, it is also paramount that interventions can be inclusive and practical. Music interventions although not universally appreciated (a participant in one study was found to be more aggressive during the music intervention (Álvarez Gómez et al., 2019) have the ability to be personalised, and perhaps more effectively implemented. The studies did not clearly account for the reasons PWD were hospitalised in acute care, given the group demographic is likely to experience poor health, this is could impact on the way interventions were received and outcomes.

A wide number of anxiety and BPSD measures were employed throughout the included studies and could also be a factor in the variable results. Anxiety is used as a measure because it is comorbid with dementia, follows a similar trajectory and is often a reason for referral to a dementia clinic (Kwak et al., 2017). It is not clear when implementing interventions what standardised rating is to be aimed for. Several measures for screening and rating rely on interviews with caregivers (the Behavioural Pathology in Alzheimer's Disease Scale (BEHAVE-AD) and Neuropsychiatric Inventory (NPI)) and this can be a stumbling point when PWD are hospitalised without a carer nearby Kwak et al. (2017). The most robust anxiety or BPSD measure should be identified and used consistently in future studies.

Interventions varied from music therapy led by music therapists to live music and singing and recorded music. Although music interventions were often delivered in isolation sometimes they were in conjunction with other interventions and over a variable time period. All these factors make direct comparison between studies difficult. Work is needed to identify the most importance aspects of using music alone as an intervention and how does duration impact on lowering anxiety in

PWD. The authors feel that music, as opposed to live music, dancing, exercise would be more feasible in acute care settings. Furthermore, in these situations it may only be possible to use music for short periods, selective implementation when patients are having a procedure or in conjunction with a daily activity that is known to make them anxious maybe most useful.

Some of the most affecting results from the included studies are around the secondary outcomes. Carers reported feelings of lower stress and noted reductions in anxiety in their family members. Staff also reported feelings of wellbeing and positive patient interactions motivating their daily roles. This is of importance as the relationship between achieving the practical daily tasks associated with acute care and the morale and happiness of staff are strongly linked. Good staff well-being is associated with good patient care, furthermore improving patient experience can directly improve staff experience (Locock et al., 2020). Changing the model of care by making practical simple changes and involving staff in patient-centred quality improvement is strongly associated with positive patient outcomes, well delivered care and improved staff mood (Locock et al., 2020).

Potential transferable knowledge derived from music-based intervention studies

Non-pharmacological interventions are best practice for reducing agitation in patients living with dementia (Edmans et al., 2021; National Institute of Health & Social Care Excellence, 2019). They are more effective in acute care settings than medication (Moreno-Morales et al., 2020).

To alleviate BPSD for PWD attending at acute care there is tentative evidence from this review that music maybe useful. It should be noted that two studies reported no change, and one noted in one particular individual, music appeared to increase agitation (Sival et al., 1997). This highlights the need for a music-based intervention to be delivered sympathetically by trained staff. More research is needed on the best time to deliver interventions and it would be useful to measure additional outcomes, such as carer-wellbeing stress or burden, reduction in length of stay or appointment time, or how long it took for the PWD at appointment.

A number of the included studies reported that staff wellbeing and morale improved, and staff sickness was lower on music-intervention days (Lee et al., 2023 Aug, 14; Helmes & Wiancko, 2006; Thompson et al., 2023). An important secondary outcome which also highlights the benefits to staff and the whole clinical environment. Staff should be trained to implement any intervention and be part of the decision making around feasibility and timeliness. Engaging staff would support policies to create dementia-friendly environments.

It is reasonable to assume that these results from acute care may be generalisable to diagnostic imaging settings. Diagnostic imaging almost always occurs in acute care settings within the bustle of a busy hospital environment, with similar pressures on staff, time and resources. Imaging also presents as a clinical environment alien to the patient, with unfamiliar staff and medical equipment, all of which our clinical experience suggests may trigger anxiety in PWD. Interventions which offer the opportunity to lower anxiety in PWD, can be easily acted on, result in rapid diagnostic scans and calm patients should be embraced.

Strengths and limitations

This is one of the first reviews on using music and music therapies in acute care to reduce BPSD in people with dementia. The review methods were rigorous and systematic over seven databases, with additional hand searching of the included references. The selected studies mixture of trial designs. These studies were independently critically appraised by all three authors and met with a high level of agreement (only one study required meeting to resolve and come to agreement). However, the field of interventions and assistive technology for PWD is a rapidly moving

field (King et al., 2021) and new research is being conducted that may have been published since the data collection in May 2024. It is possible, despite methodological rigor that some studies were missed, particularly if not published in English.

Unfortunately, no studies using music to lower BPSD for PWD in a diagnostic imaging settings were found, although a systematic review has been published on non-pharmacological interventions in adults with anxiety, but without known dementia, in advance of imaging procedures (Sweeting et al., 2024). This study concluded that although there were low-quality studies, the selected interventions (patient information, cognitive strategies and music) were shown to be practical to include in an imaging setting.

We accept the limitations of this scoping review did not consider music interventions for non-dementia patients in acute care settings. However, the specific aims and interests of the authors are around improving care pathways, patient experience and outcomes for PWD when attending acute care and feel this is an underexamined and little explored area.

Most of the studies were not blinded to the interventions, understandably this is difficult to achieve given the patient demographic, the sites (acute care) and if audible music was employed. The non-blinded studies have a risk of bias. We have suggested future study designs and outcomes measures that would advance the field more effectively.

Implication for research and practice

Acute care is a challenging environment in which to implement music-based interventions to reduce anxiety in PWD in particular using the rigorous methodology of high-quality research. Blinding is almost impossible to achieve because of the attributes of the intervention and the nature of the group, PWD, which can lower the appraised quality of studies.

In order that rigorous research can occur and interventions be tested, health and social care staff need training on dementia and to commit to innovations that may lead to improvement in treatment and care. If staff are trained and happy to implement this would facilitate the practice of any interventions. Music interventions are seen as more difficult to administer than pharmacological ones and the PWD's family needs to be involved in order to help define the best fit music genre for the individual. There are going to be challenges to implementing in music in busy geriatric and acute-care wards and families of PWD already prepared with downloaded music and headphones may ease this process. As the generation of adults of the last thirty years, many of whom have their own curated favourite music playlists on their smart-phones become the PWD of tomorrow, then this problem may solve itself.

It is imperative we optimise the care-pathways of PWD. Alzheimer's Disease International recommends that PWD receive high quality compassionate care and should be discharged as rapidly as possible in order to reduce the impact of long stays and reduction in capacity (Alzheimer's Society, 2009). In healthy people over 80 years old, time in hospital is associated with general declines in mobility, physical and social activity (Tavares et al., 2021). This decline is accelerated for PWD, studies report increased risks of poor outcomes including infections, functional and nutritional decline, mortality or institutionalisation on discharge (Marengoni et al., 2011; Hapca et al., 2018; Fogg et al., 2018). Interventions such as music in acute care settings have the potential to allow rapid passage through acute care and return to familiar environments for PWD.

This study has highlighted the need for future studies to identify successful interventions to improve the experience and outcomes for PWD in acute care settings, including when attending Radiology Departments. This review has tentative support for music as a realistic intervention. Future research designs should standardise measures of BPSD but also include other outcomes, such as time in hospital, time taken for procedure, staff measures such as morale and positive mood and the need for psychotropic medication use. Larger sample sizes are

to be aimed for, where possible greater than 50. Recruitment and retention could be improved by engaging carers as well as PWD, and involving staff in designing and implementing the intervention. Personalising sounds and the type and length music intervention need further investigation along with designing robust RCTs which have the potential be blinded. The authors recognise the practical difficulties of providing music-based interventions in acute care. However, by engaging staff and carers in the process of modifying the environment with creative interventions and involving all parties, the benefits to patients, staff wellbeing and in reducing in time spent in hospital could be profound for people living with dementia.

Conclusions

The current review demonstrates that despite a number of studies investigating the effectiveness of music and music therapies to lower anxiety in PWD, the small participant sizes, the small number of rigorous RCT and the variability in outcome measures makes it difficult to conclude definitively the impact of music. However, in this review the overall effect of music interventions was positive on the anxiety of PWD.

There is a need for further high-quality targeted interventions with a standardised approach to measuring anxiety in PWD in acute care. In particular, as over 90% of all patients undergo some diagnostic imaging during their healthcare pathway, this review has also highlighted the need for high quality research into interventions to improve the experience and outcomes of PWD when attending the Radiology Department.

CRedit authorship contribution statement

Victoria McArthur: Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Susan Everington:** Writing – review & editing, Data curation. **Martyn Patel:** Writing – review & editing, Supervision, Methodology, Data curation.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Victoria McArthur reports financial support was provided by Norfolk and Norwich University Hospitals NHS Foundation Trust. Victoria McArthur reports a relationship with Norfolk and Norwich University Hospitals NHS Foundation Trust that includes: employment. Susan Everington reports a relationship with Norfolk and Norwich University Hospitals NHS Foundation Trust that includes: employment. Martyn Patel reports a relationship with Norfolk and Norwich University Hospitals NHS Foundation Trust that includes: employment. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

Acknowledgements

The authors would like to thank the librarians in particular John Losasso for his advice in designing the search strategy and are grateful to the Sir Thomas Browne Library NNUH for support.

Financial Support. Financial support for the study was provided by the NNUH (Research and Capability Funding 2023–2024) which paid for research capacity for VM.

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